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A PECULIAR MODIFICATION AMONGST PERMIAN DIPNOANS.

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THE genus *Sagenodus* is represented in this country by less than a dozen species, of which only three have been described from the Permian of Texas. These are *S. dialophus*, *S. periprion* and *S. porrectus*, all founded on detached dental plates of small size. The presence of a fourth species, different from any hitherto described, and displaying quite unusual modifications amongst ceratodonts, is indicated by several well preserved mandibular and palatine dental plates which have recently been brought to light by Dr. E. C. Case, of the State Normal School at Milwaukee, and kindly placed by him in the hands of the writer for description.

The present species occupies a unique position amongst fossil dipnoans in having a dentition adapted for cutting instead of crushing, thus paralleling the conditions found in certain Palæozoic sharks and in recent Gymnodonta. This divergence is the more striking in view of the singularly uniform type of dental system pervading lung-fishes throughout their entire geological history. Whether so extreme a variation is to be correlated with the change from marine to brackish-water conditions that took place during the Permian, with its very pronounced effects upon the environment and food-supply, may perhaps be plausibly conjectured.

In the new form, which may be named *Sagenodus pertenuis* in allusion to its chief peculiarity, the coronal grinding surface has become reduced to practically *nil* in the lower jaw, owing to compression of the inner margin into a sharp cutting edge, and disappearance of all except one of the outer radiating ridges. The upper dental plates differ from the lower in that two, instead of one, abbreviated coronal ridges are given off from the sharp angulation of the inner margin. The latter forms a continuous crest extending nearly to the symphysis anteriorly, and cor-

responds to both the foremost and hindmost of the coronal ridges in *Ceratodus*, plus the intermediate space. Hence it is proper to speak of an anterior and posterior, and one or two intermediate coronal crests as the case may be, according as we have to deal with mandibular or palatine dental plates. All of these coronal crests are serrated, the anterior one — which is at the same time the longest — coarsely, and the others finely, with sometimes as many as six or seven serrations each. The cutting edge in worn specimens furthermore displays a minutely crenulated appearance, owing to exposure of the dentine tubules, a condition very frequently observed in sharks' teeth. Both sides of the thin

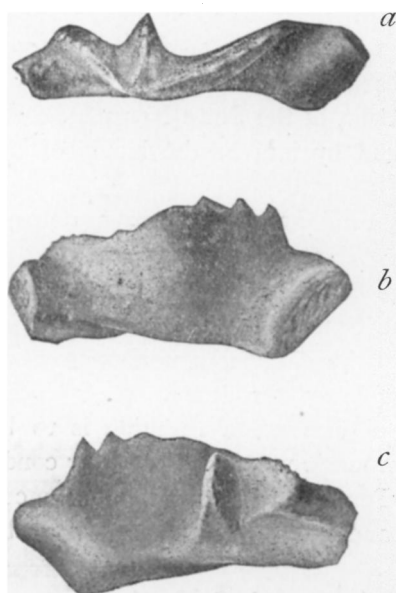


FIG. 1. *Sagenodus pertenuis* sp. nov. Permian; Texas. Left lower dental plate seen from the superior (a), inner (b) and outer (c) aspects $\times 2\frac{1}{2}$. The roughened sutural surface at the symphysis is shown in C.

cutting edge exhibit a shining enameled surface, which passes gradually into a narrow base of vaso-dentine; and in the case of the mandibular dental plates at least, the pair was suturally united at the symphysis, much in the same fashion as in *Ptyctodus* and *Rhynchodus* (Fig. 1 a, b).

The six specimens which the writer has examined are of comparatively small size, none exceeding a total length of 2 cm. and a height of 0.8 cm. In some examples the angulation of the inner margin is considerable, amounting almost to a right angle, and the short intermediate ridges

have a tendency to become slightly curved backward. None of the dental plates exhibit marks of contact with those of the opposite jaw, but it is natural to suppose from the manner in which the lower pair were united, that essentially the same sort of contrivance was developed here as we have become familiar with in *Peripristis* from the upper Carboniferous, a modification which

is truly remarkable. When we recall also the aberrant series of Edestus-like sharks that flourished contemporaneously, we are struck with the fact that in two of the most conservative and persistent groups of fishes, namely the ceratodonts and cestra-cions — both of which have had a continuous existence ever since the Devonian, — the extreme of variation was attained toward the close of the Palæozoic.

Another interesting feature to be brought forward in connection with the present form is its apparently wide distribution ; and bearing in mind the world-wide scattering of the Edestus series that took place during the late Palæozoic, we note that the stimulus which quickened variation and distribution was responded to simultaneously by the two groups of fishes exceeding all others in longevity, after which they relapsed into sluggishness. The specimens obtained by Dr. Case, and one or two others belonging to the Münich Palæontological Museum, the latter having been acquired through Mr. Charles Sternberg, are all from the Cimarron series (upper Permian) of Wichita County, Texas. But it is further to be recorded upon the authority of Dr. Broili of Munich, who recently submitted the specimens under his charge for identification, that precisely the same form of tooth occurs in the Permian of Russia. Thus we have valuable additional evidence from the side of vertebrate palæontology regarding the homotaxial relationships of the Texas "Red Beds." The distinguishing features of the above described species may be briefly summarized as follows : — Dental plates relatively small, thin, the inner margin strongly angulated and sharpened into a continuous cutting edge, with a few coarse serrations in advance of, and finer ones behind the angulation. Mandibular dental plate with but one, and palatine dental plate with two short and narrow coronal ridges extending outwardly from the angulation of the inner margin, their crests finely serrated. Plates entirely without coronal grinding surface.



FIG. 2. *Sagenodus pertenuis*
sp. nov. Oral aspect of left
upper dental plate. $\times 2\frac{1}{2}$.